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PRESENT STATUS OF SEAWEED CULTURE IN KOREA

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ABSTRACT

Seaweeds from natural stocks as well as from aquaculture have been widely utilized in Korea for a long time. *Porphyra* was first cultivated 360 years ago. The culture of *Undaria pinnatifida* was introduced more than 10 years ago. *Laminaria* spp. were also introduced by employing an artificial culture method. *L. religiosa* was grown in natural beds along the middle part of the eastern coast after the initiation of farming of this species. At present, production of *U. pinnatifida* from farms is much greater than the natural harvest.

The most widely cultured species of *Porphyra* is *P. yezoensis*, but *P. tenera* is also farmed in some areas. Recently, some varieties that were known to grow faster and to be more resistant to diseases were introduced from Japan. After *Conchocelis* was successfully grown, the artificial seeding method became very popular.

The production of cultured *Porphyra* was 34 025 mt in 1980; *U. pinnatifida*, 153 333 mt in 1979; *Laminaria*, 5192 mt in 1979.

INTRODUCTION

Seaweeds from natural stocks and aquaculture have been widely utilized in Korea for a long time now. Chung (1814) described thirty-four species of seaweeds with particular emphasis on their use as human food.

Porphyra was first cultivated on tidal flats of Kwang-Yang Bay near the estuary of the Seom-Jin River 360 years ago. Later it was grown on shrub branches standing on tidal flats. Since then more efficient culture methods have been developed. Split-bamboo blinds replaced the shrub branches as culture substrates. Initially, one lateral margin of the split-bamboo blind was fixed to the sea bottom and the other side was left free in the water at certain level within the tidal range. In the 1930's, this method was modified by setting the split-bamboo blind substrate in a horizontal position.

Undaria pinnatifida has been harvested for a long time from natural rocks by using a method that eliminates 'pest' weeds such as *Sargassum*, *Phyllospadix*, and articulated coralline. The cultivation of the species started in 1970 and at present the production from cultures is much higher than natural harvests.

Laminaria spp. are distributed along the eastern coast of northern Korea. In the south, where it is too warm for the natural growth of the species, *L. japonica* and *L. religiosa* have been introduced employing an artificial culture method. *L. religiosa* later started to grow on natural rocks along the middle part of the eastern coast sometime after the initial farming of this species.

As these species of sea vegetables are now grown extensively by a number of sea farmers, seedling production which is undertaken by highly skilled farmers is a major concern of the seaweed industry in South Korea.

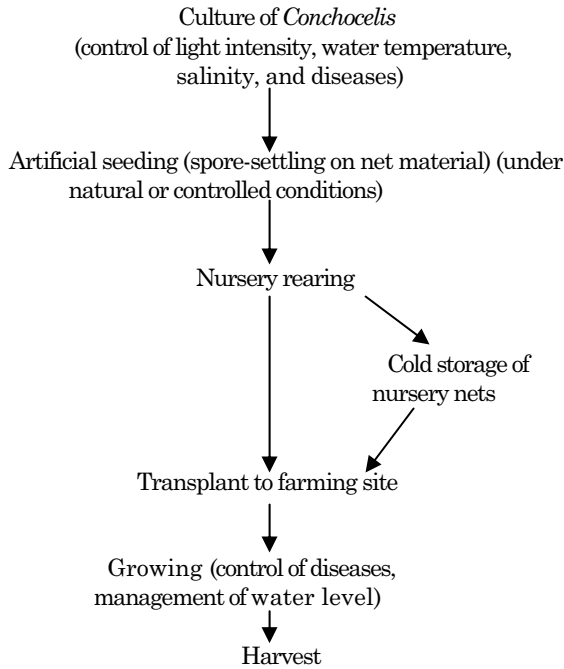
PORPHYRA CULTURE

Among *Porphyra* species, *P. yezoensis* is at present most commonly cultivated although *P. tenera*, which used to be more popular, is still grown in some farms (Kang 1970). Recently, some varieties that grow faster and are more resistant to diseases were introduced from Japan. The limited success in the cultivation of these varieties may be due to differences in environmental conditions and the lack of experience of farmers in culturing new cultivars.

About 4 to 5 years ago, *Conchocelis* was cultured by the free-growing method before the technique of substrate culture in shells. However, farmers generally do not utilize this method. They obtain their seeds from the National Fisheries Research and Development Agency of Korea or import them from Japan to get new strains.

Before the technique of artificial seeding from *Conchocelis* cultures was developed about 10 years ago, farmers obtained their seeds from natural spores settling in the field. Now, the old method of natural spore-settling is no longer practiced. Artificial seeding is usually carried out in large plastic envelopes. The cultured *Conchocelis* and nets for spore-settling are placed inside the envelope containing sea water. The envelope is then set under water in the field to simulate or approximate natural conditions. Since seeding requires exact timing of spore release, farmers usually prefer artificial seeding under natural conditions than under fully controlled conditions in tanks installed on land.

The *Porphyra* culture method is as follows:



The nets are then suspended in seawater during the nursery growing period of about 55 days. The grow-out nursery nets are almost directly transplanted to the final growing ground. Only very few farmers keep some of the nursery nets refrigerated.

The old practice of using split-bamboo blinds as culture substrate has been substituted by the net-culture method which is more convenient and efficient for spore-settling. The seeded nets ($1.8 \times 4\text{m}$) are usually placed and maintained at a certain level within the tidal range by attaching them to supporting poles. The nets float near the water surface and are exposed to the air twice a day during the spring low-tide period. The average time of each exposure is 3 to 4 hours.

If the exposure time is short during the early stages of the culture period, *Porphyra* grows fast but is more vulnerable to diseases. On the other hand, with a long exposure period it grows slowly but is more resistant to diseases. Moreover, when warm temperatures accompany the calm weather during December, it is very difficult to grow healthy *Porphyra* by adjusting the exposure time alone. However, farmers can grow *Porphyra* fast and increase yields by reducing the exposure time in December. But the next crop usually suffers from diseases.

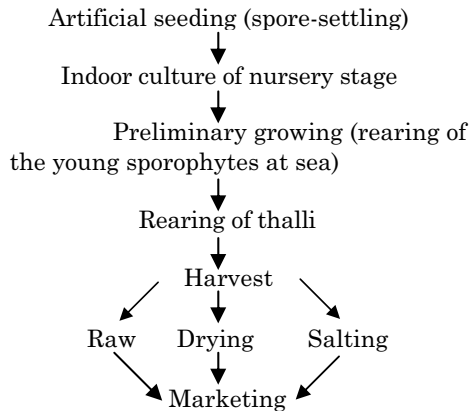
The nets in the drift system are always floating on the surface of the water and maintained in place by anchors. This culture system is beginning to be practiced toward the open sea because of the pollution of inland seawaters. Recently, production of *Porphyra* has expanded to meet increasing demands. However, there is the need to improve its quality.

UNDARIA CULTURE

Korea has two species of *Undaria*: *U. pinnatifida* and *U. peterseniana*. Because the distribution of the latter is restricted to Cheju Island and its vicinity, it is not as popular as the widely distributed *U. pinnatifida* which is preferred by the Korean people. The thalli of another species, *Costaria costata*, is also utilized as food.

The culture technique of *Undaria* was introduced more than ten years ago in the vicinity of Pusan (Saito 1964) which is located along the country's southeastern coastline. About 70% of the total production of the species in Korea today, however, is produced along the southwestern coastal areas.

The culture and production of *Undaria* involve:



Artificial seeding is usually carried out from late May to early June when the seawater temperature increases to around 17°C. When shade-dried sporophylls are immersed in seawater, the zoospores are discharged. The zoospores germinate into gametophytes which grow very fast up to the young sporophyte stage when the water temperature is below 20°C until July before the onset of high water temperature. If light intensity is reduced, gametophytes grow only into a few cells. Growth of gametophytes is slow until August since water temperature thereafter begins to increase.

The success of *Undaria* culture basically depends on the development of the young sporophytes. Factors like high water temperature and transpar-

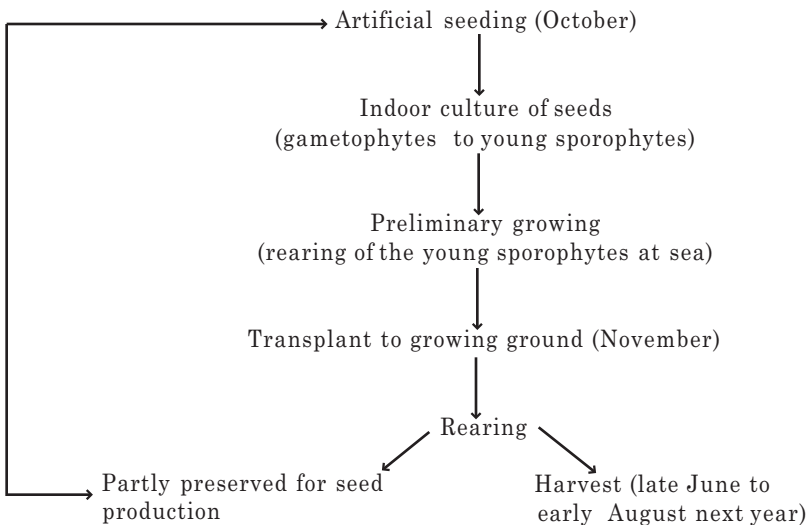
ency as well as unstable sea conditions owing to prevailing strong winds and fluctuation of water temperatures apparently influence the growth of young sporophytes. Recently, certain diseases caused by bacterial pathogens and parasites, such as *Thalestris* sp. and other copepods, have been observed in cultures.

The market price of the dried product fluctuates considerably. At the very start of the harvest season in December, it is about ten times as much as in February to April. Therefore, some farmers start to grow young sporophytes early in September, in spite of the adverse effects of warm temperatures, so as to harvest in December when prices are high. However, when fully grown sporophytes experience high water temperatures during the hot season, survival of the sporophytes is low.

LAMINARIA CULTURE

Although *Laminaria* generally thrives in cold temperate waters, it is now possible to farm it in warmer temperate waters through artificial seed production (Li 1969). In this method, spores are collected on strings from blades of mature *Laminaria* in May and then kept in the dark and at low temperature indoors during summer in Japan. They are moved to the sea in autumn and then grown to marketable size by July in the following year. When cultured from spores, the seaweed still behaves as a biennial and develops the same thickness and taste as naturally grown individuals. *Laminaria* is now cultured in South Korea in areas other than its natural habitats.

The culture of *Laminaria* in Korea consists of the following:



In Korea, seedling culture begins in October and the rearing of young sporophytes is carried out from late October to November when the water temperature is below 18°C. It is harvested by late July before the water temperature rises to 20°C. In summer, typhoons may damage seaweeds farms, and the cultures may be affected by the growth of bryozoans.

PRODUCTION OF CULTURED SEaweEDS

The data on the production of cultured *Porphyra*, *Undaria*, and *Laminaria* in South Korea in 1975-1980 are given in Table 1. Annual total harvests for each seaweed during this period varied greatly, but *Undaria* clearly constituted the bulk, followed by *Porphyra* and *Laminaria*. *Porphyra* production

Table 1. The production of cultured seaweeds in South Korea

Species	Production (metric tons)					
	1975	1976	1977	1978	1979	1980
<i>Porphyra</i>	-	29 090	11 750	23 610	29 240	34 025
<i>Undaria</i>	132 328	161 770	208 620	158 342	153 333	-
<i>Laminaria</i>	2 759	8 342	2 122	5 516	5 192	-

was a high 34 025 mt in 1980. *Undaria* and *Laminaria* accounted respectively for 153 333 and 5 192 mt in 1979; no data are available for both seaweeds for 1980.

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